

New species of tropical littoral fish found in Canarian waters. Oil platforms as a central introduction vector

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ABSTRACT

The occurrence in Canarian waters of 14 species of tropical littoral fish that have not previously been cited has now been recorded. One amongst them, *Parablennius goreensis*, might have arrived through its own dispersal means and has rapidly spread throughout the archipelago, favoured by the increasingly warm waters. The appearance of three of these species clearly owes to grown specimens of fish bred in aquariums being released into the sea. At least eight species are directly linked to transport connected with oil platforms' fouling. Such platforms coming from Brazil, the Caribbean and the Guinean Gulf have frequently anchored in the two main Canarian ports in recent years. The presence of tropical species originally coming from these three biogeographical Atlantic provinces has been recorded in Gran Canaria, namely that of 4 species of acanthurids original from America. Most records come from the port area of Puerto de Las Palmas harbour and its surroundings, but some specimens have been caught in southern and northern sectors on the island, far away from the port area. At least two of the species whose presence can be attributed to this type of transport – *Abudefduf hoefleri* and *Hypleurochilus pseudoaequipinnis* – are currently breeding in Gran Canaria.

Key words: littoral fish, tropicalization, introduced species, oil platforms, Canary Islands

RESUMEN

Se registra la presencia en aguas canarias de 14 especies de peces litorales tropicales no citadas anteriormente. Una de ellas, *Parablennius goreensis*, puede haber llegado por sus propios medios de dispersión y se ha expandido rápidamente por todo el archipiélago, favorecida por el calentamiento de las aguas. La aparición de tres de la especies se debe cla-

ramente a la liberación al mar de ejemplares grandes que han crecido en acuarios. Al menos ocho especies se relacionan claramente con el transporte asociado al fouling de las plataformas de petróleo procedentes de Brasil, El Caribe y el Golfo de Guinea. Es en Gran Canaria donde se ha detectado la presencia de las especies tropicales procedentes de estas tres provincias biogeográficas del Atlántico, destacando 4 especies de acantúridos de aguas americanas. La mayor parte de los registros proceden de la zona portuaria y proximidades del Puerto de Las Palmas, pero algunos ejemplares han sido observados y capturados en sectores lejanos del sur y norte de la isla. Al menos dos de las especies cuya presencia se puede atribuir a este transporte, *Abudefduf hoefleri* e *Hypleurochilus pseudoaequipinnis*, se reproducen ya en Gran Canaria.

Palabras clave: peces litorales, tropicalización, especies introducidas, plataformas petrolíferas, Islas Canarias

INTRODUCTION

Canarian littoral ichthyofauna has experienced an obvious tropicalization process since the 90s. This process becomes apparent through the occurrence of a large number of tropical species (BRITO *et al.*, 2005, 2007, 2011; GARCÍA-MEDEROS & TUSSET, 2014; OTERO-FERRER *et al.*, 2015; ESPINO *et al.*, in press) – some have successfully settled in the area –, as well as the enlargement of the distribution range towards the eastern islands of other thermophilic species that were only known to inhabit the warmer waters of the western islands of the archipelago (BRITO *et al.*, 2005). The same process is true for northernmost areas in the north-eastern Atlantic and the Mediterranean (i. e., BAÑÓN *et al.*, 2010; ZENETOS *et al.*, 2012; AFONSO *et al.*, 2013), which has led to the occurrence of species that are well established in the Canarias in some cases. This process is closely linked to the increasingly warm water temperatures registered in this areas as a result of climate change, but introductions owing to anthropogenic activities have also been significant.

Certain thermophilic species recorded in the Canarias seem to respond to a range enlargement process through their own dispersal means – high mobility in juvenile and adult specimens, rafting-like behaviour, and larval dispersal –. But this option seems unlikely for a number of cases, based on the species' biology and their geographical distribution areas. Therefore, their presence can be explained by introductions linked to anthropogenic activities – ballast water, aquarium specimens being released, oil platforms – (BRITO & FALCÓN, 1996; BRITO *et al.*, 2005, 2011). In both scenarios, occurrence has been favoured by the increase in temperatures experienced in shallow waters, which has been estimated at an average value of 0.28 °C per decade for the period covering from 1982 to 2013, more markedly so during the wintertime (VELEZ *et al.*, 2015).

Several introduced species have only been registered in port areas and their surroundings and in small numbers too (BRITO & FALCÓN, 1996; BRITO, *et al.*, 2005, 2011), which leads to thinking that they have arrived transported either by ballast water or associated to oil rigs' fouling. *Chaetodon sanctaehelenae* and *Cephalopholis taeniops* are clear examples of this. Regarding the release of fish from aquariums, the only case documented to the date is that of *Pomacanthus maculosus*.

The importance of the abovementioned activities contributing to the introduction of thermophilic species has continued to grow since the last detailed analysis of the tropicalization process in Canarian ichthyofauna (BRITO *et al.*, 2005), especially in regards to the arrival of oil platforms. The ports of Santa Cruz de Tenerife and Las Palmas de Gran Canaria have become major hubs for repair works of this vessels arriving from tropical areas in the American and African Atlantic Ocean in recent years.

Platforms fixed or temporarily anchored in an area become an extension to the coastal habitat for littoral species and are able to assimilate large amounts of fouling. Algal spores and invertebrate larvae rapidly colonize submerged portions of platform structures, establishing a fouling assemblage which provides food and shelter for associated fish (i. e., WOLFSON, 1976; RAUCH, 2004; FRIEDLANDER *et al.*, 2014). Subsequent slow navigation towards other areas makes it possible for fouling associated fish to travel long distances, as has previously been proven to happen (BRITO *et al.*, 2011). If platforms remain anchored in tropical areas for extended periods of time, it is even possible for a reef-like structure to develop (i. e., FERREIRA *et al.*, 2006). This way, when platforms are moved they can give rise to the so-called “moving reefs in the ocean” process.

The transporting process for fouling-associated species in oil rigs is very little known. This emerging activity can result in big transformations, namely due to species travelling from tropical to subtropical areas in the current climate change context, such as in the case in hand. The risk of significant changes in the way local faunas and ecosystems is real. We cannot rule out potential invasive processes, especially when it comes to highly altered ecosystems such as the one found in the Canary Islands (i. e., HERNÁNDEZ *et al.*, 2008; CLEMENTE *et al.*, 2010).

In this study, we have compiled data available from the Red de Observadores del Medio Marino (RedPROMAR) network belonging to the Regional Government of the Canary Islands (<http://www.redpromar.com/>) – a network comprised by observers using the “citizen science” concept to monitor the marine biodiversity –, as well as information we have collected ourselves in order to update what is currently known regarding the tropicalization process and the species introduction process. We have recorded new species, their geographic distribution, the most probable way of arrival and their distribution range as found in the archipelago. Information in relation to the occurrence of fish that are very rarely recorded is also provided. Up until now, it has not been possible to take direct samples at the platforms in order to carry out a more thorough study inclusive of a quantitative study.

MATERIAL AND METHODS

Images and data collected by the RED PROMAR network belonging to the Regional Government of the Canary Islands were used. These had been contributed by numerous divers and fishermen. Some caught specimens belonging to the same source were also examined. Furthermore, entries available in our data base were also browsed. The Figure 1 shows the locations where has been recorded species presence (pictures, data and captures).

We were able to identify most species using images. This was not possible for a few cases in which we resorted to catching specimens in several locations in Tenerife and Gran Canaria. This was necessary specifically for two blennoids and one pomacentrids.

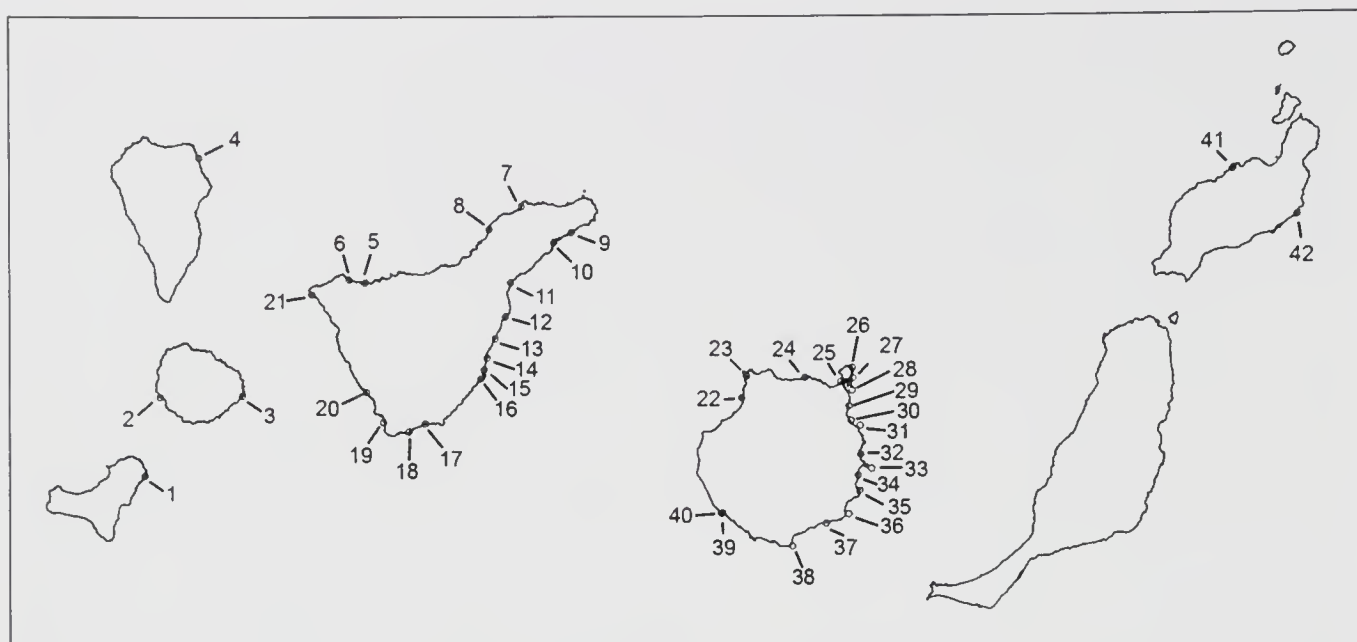


Fig. 1.- Locations where have been registred exotic species: 1 La Caleta, 2 Valle Gran Rey, 3 San Sebastián, 4 Charco Azul, 5 Garachico, 6 Los Silos, 7 Pta. El Hidalgo, 8 Tacoronte, 9 Las Teresitas, 10 Santa Cruz, 11 Las Caletillas, 12 Puertito de Güímar, 13 El Tablado, 14 Las Eras, 15 El Porís, 16 Abades, 17 Los Abrigos, 18 Montaña Amarilla, 19 Arona, 20 Adeje, 21 Pta. Teno, 22 Agaete, 23 Sardina, 24 El Puertillo, 25 Las Canteras, 26 La Isleta, 27 Puerto de Las Palmas, 28 Pta. Dique Reina Sofía, 29 San Cristóbal, 30 Costa de Jinámar, 31 Bajas de Jinámar, 32 Tufía, 33 Baja de Gando, 34 El Burrero, 35 El Cabrón, 36 El Plasencia, 37 Castillo del Romeral, 38 Maspalomas, 39 Playa de Mogán, 40 Pto. de Mogán, 41 La Santa, 42 Costa Teguisse.

Specimens have been temporarily stored in the ichthyological collection of the Marine Sciences Unit of the La Laguna University.

In order to study morphometric and meristic characteristics of the specimens considered for this research, we followed the criteria from BATH (1997) for blennoid specimens – except for the caudal fin, for which only branched rays were registered – and EDWARDS (1986) for pomacentrids.

RESULTS

A total of 14 tropical species that had not been previously listed have been recorded. Their characteristics and the data collected are detailed below:

Blennidae

Parablennius goreensis (Valenciennes, 1836) (Table 1; Plate 1). Seven specimens were examined, having been caught in two localities on Tenerife (Santa Cruz and Las Teresitas). Photographs and records of a number of specimens found in 14 localities on Tenerife (Punta de Teno, Los Silos, Garachico, Adeje, Abades, El Porís, Punta del Hidalgo, Tacoronte, Puertito de Güímar, Las Caletillas, Los Abrigos, Montaña Amarilla, Las Teresitas y Santa Cruz), 1 on La Palma (Charco Azul), 2 on Lanzarote (Costa Teguisse y La Santa), 4 on Gran Canaria (Mogán, Tufía, Sardina y El Burrero), 2 on La Gomera (Valle

Table 1.- Counts and measurements (in mm) on specimens of *Parablennius goreensis* from the Canary Islands.

Specimen	Sex	Total length	Standard length	Head length	Eye diameter	Dorsal fin rays	Anal fin rays	Pectoral rays	Branched caudal rays
1	male	77	63	15.8	4.5	XII + 19	II + 21	14 / 14	8
2	male	68	57	14.5	4.0	XII + 19	II + 21	14 / 14	7
3	male	76	63	15.5	4.5	XII + 19	II + 21	14 / 14	9
4	male	76	63	15.5	4.5	XII + 19	II + 21	14 / 14	9
5	male	68	57	14.2	4.0	XII + 19	II + 21	14 / 14	9
6	female	58	48	12.0	3.7	XII + 18	II + 21	14 / 14	8
7	—	38	31	8.5	3.2	XII + 19	II + 21	14 / 14	9

Gran Rey y San Sebastián) and 1 on El Hierro (La Caleta) were used. It inhabits rocky bottoms covered in algal turfs from 0.5 to 25 m deep – more frequently found from 2 to 10 m –, as well as in anchoring ropes showing fouling. It is currently very abundant. Average recorded density as studied through 6 transects carried out in two localities on Tenerife in August 2015 resulted in 2.0 specimens per 100m². Specimens in all sizes were found. Its main differences as compared to its closest species within the same genus – *P. marmoreus* and *P. salensis* – are the number of soft rays in the dorsal and anal fins, the way the spot is located in between the first dorsal rays, and the ventral fin’s structure (see Bath, 1990). It is distributed around the tropical eastern Atlantic, its northern limit known to the date being located at the Banc d’Arguin (Mauritania) (BATH & WIRTZ, 1992). It was first recorded in the Canarias on Tenerife (Punta de Teno) in March 2012. Photographs (Plate 1, D) show a nesting male with mating livery.

Hypleurochilus pseudoaequipinnis (Bath, 1994) (Table 2; Plate 2). Three specimens were examined, having been caught in two localities on Gran Canaria (Tufia and Agaete). Several photographs and data on the abundance of specimens found in 3 localities on the same island (Tufia, Las Canteras and Agaete) were used. The only photographed specimen at Las Canteras beach was observed at a rocky bottom in shallow waters, but the rest of them have been exclusively recorded around floats and anchoring ropes where fouling was present. The last population study carried out in June 2014 showed 40 specimens in Agaete and 17 in Tufia, in a number of different sizes. Its main differences as compared to its closest species within the same genus – *H. aequipinnis* – are its colouring and the number and location of head lateral line pores (see BATH, 1994). It is widely distributed around the tropical western Atlantic – it has only been listed in São Tomé and Príncipe in the eastern Atlantic (WIRTZ *et al.*, 2007) –. It was first recorded in Tufia in April 2013, and evidence proves they currently breed in the two of the abovementioned locations.

Table 2.- Counts and measurements (in mm) on specimens of *Hypleurochilus pseudoaequipinnis* from the Canary Islands.

Specimen	Sex	Total length	Standard length	Head length	Eye diameter	Dorsal fin rays	Anal fin rays	Pectoral rays	Ventral rays
1	male	51	43	12.0	3.5	XII + 13	II + 15	14 / 14	I + 4 / I + 4
2	female	58	47	14.0	4.0	XII + 14	II + 16	14 / 14	I + 4 / I + 4
3	female	47	40	11.0	3.5	XII + 14	II + 16	14 / 14	I + 3 / I + 4



Plate 1.- *Parablennius goreensis*. A) female specimen; B y C) male specimens; D) parental care behavior in nesting male (see embryos in the top part of the crevice); E) males fighting.

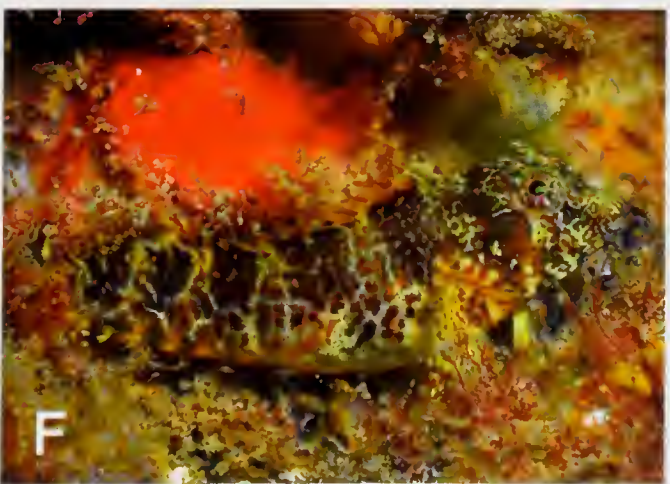
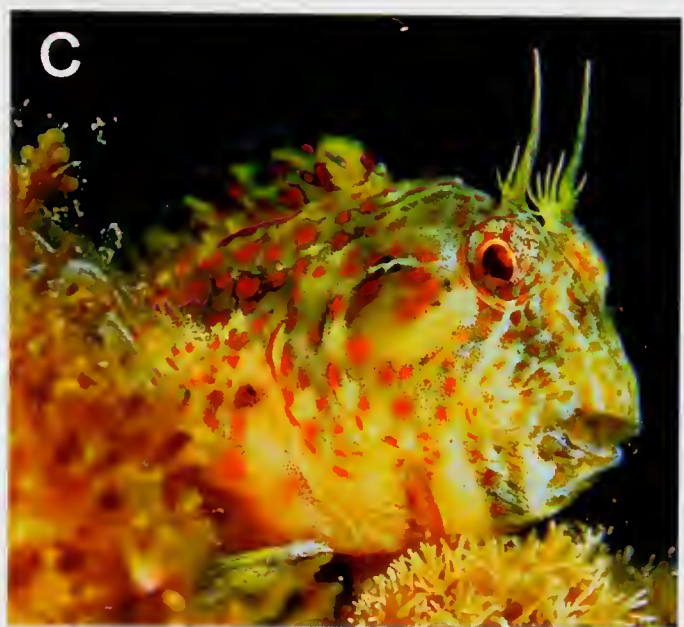


Plate 2.- *Hypleurochilus pseudoaequipinnis*. **A-C)** males over fouling-covered anchor bouys; **D)** specimen inhabiting an anchor rope covered in fouling; **E y F)** females over fouling-covered anchor bouys.

Acanthuridae

Acanthurus bahianus (Castelnau, 1855) (Plate 3, A). Two specimens photographed on Gran Canaria, one at Puerto de Las Palmas harbour, underneath an oil rig, 10 metres deep, in April 2013. Said platform presented plenty of fouling comprised by large masses of coral. The other one at Baja de Gando, 15-20 metres deep, in June 2014. This species is distributed throughout the tropical and subtropical coastlines of Brazil and in the central Atlantic islands (Fernando de Noronha, Atol das Rocas, Trindade, Ascension Island and Saint Helena) (BERNAL & ROCHA, 2011).

Acanthurus chirurgus (Bloch, 1787) (Plate 3, B). Photographs of two specimens, one taken in March 2013 in the outer area of the Puerto de Las Palmas harbour dike and the other at Maspalomas in June 2014, where the specimen was caught in a fishing trap. This species' area of distribution is located in the western tropical Atlantic – two records of specimens expatriated to the eastern tropical Atlantic (FROESE & PAULY, 2015; BRITO *et al.*, 1999) –.

Acanthurus coeruleus (Bloch & Schneider, 1801) (Plate 3, C). One specimen was examined – 25 cm total length –, having been caught in the outer area of the Puerto de Las Palmas harbour dike in July 2015. Three photographs taken in the same area at approximately 15 metres of depth in March 2013. This species shows an area of distribution covering the tropical and subtropical western Atlantic and has also been listed in Ascension Island (FROESE & PAULY, 2015).

Acanthurus tractus (Poey, 1860) (Plate 3, D). Photographs of three specimens, one taken in March 2013 in the outer area of the Puerto de Las Palmas harbour dike at 15 metres of depth; another one taken in rocky reef front the city, south the harbour, in April 2014 at 15 metres of depth; and a third one taken in Baja de Gando in June 2014, 15-20 metres deep. This species' area of distribution is located in tropical and subtropical coastlines of the north-western Atlantic, from Massachusetts and Bermuda to Trinidad and Tobago, including the Gulf of Mexico and the islands of the Caribbean (BERNAL & ROCHA, 2011).

Pomacentridae

Abudefduf cf. *taurus* (Müller & Troschel, 1848) (Plate 4, B). Photograph of a rod-caught specimen taken at Puerto de Mogán port in August 2015. This species has a tropical Amphi-Atlantic distribution (FROESE & PAULY, 2015).

Chromis multilineata (Guichenot, 1853) (Plate 4, C). Photographs of three specimens taken in June 2015 in the outer area of the Puerto de Las Palmas port dike at 15 metres of depth. This species has a tropical Amphi-Atlantic distribution (FROESE & PAULY, 2015).

Serranidae

Cephalopholis cf. *cruentata* (Lacepède, 1802) (Plate 4, D). Photograph of a specimen caught by a spearfishing in the southern area of Gran Canaria (between Tauro and Taurito) in 2012. This species' area of distribution is located in the tropical western Atlantic (FROESE & PAULY, 2015).

Paranthias furcifer (Valenciennes, 1828) (Plate 4, E-F). One specimen was examined – 34 cm total length –, having been caught in Bajas de Jinamar (Gran Canaria) at 15 metres of depth in May 2015. Another specimen was photographed in the same location and on the same date. Photographs and data were taken of a 20-specimen catch in Puerto de Las Palmas harbour, facing an anchored oil rig, in March 2015. Photographs of yet another four specimens caught in the same area were taken in March 2015. This species has a tropical amphi-Atlantic distribution (FROESE & PAULY, 2015).

Chaetodontidae

Heniochus intermedius (Steindachner, 1893). Three specimens were photographed in Gran Canaria (El Cabrón and Puerto de Las Palmas) between 2013 and 2014, at depths ranging from 18 to 30 m. Its original area of distribution is located in the western Indian Ocean (the Red Sea and the Gulf of Aden) and it is sometimes collected for the aquarium trade (FROESE & PAULY, 2015).

Heniochus acuminatus (Linnaeus, 1758). Photograph of one specimen in the southern area of Tenerife (Arona) in June 2014. Its original area of distribution is located in the Indo-Pacific: East Africa and Persian Gulf to the Society Islands, north to southern Japan, south to Lord Howe Island and throughout Micronesia; it is collected for the aquarium trade (FROESE & PAULY, 2015).

Pomacanthidae

Pomacanthus paru (Bloch, 1787) (Plate 4, G). Photograph of an adult specimen caught in a fishing trap at 18 metres of depth in Jinamar (Gran Canaria) in August 2015. This species shows an area of distribution spreading over the tropical western Atlantic; it is also present in central Atlantic islands of Ascension and St. Paul's Rocks (FROESE & PAULY, 2015). The young are regularly collected for the aquarium marine fish trade (PYLE *et al.*, 2010).

Chaetodontoplus septentrionalis (Temminck & Schlegel, 1844) (Plate 4, H). A specimen caught in Mogán port (Gran Canaria) in August 2015. Its area of distribution comprises the western Pacific: Malay Peninsula, northward to southern Japan (FROESE & PAULY, 2015). It is collected for the aquarium marine fish trade (ALLEN, 2010).

When examining photographs and data, other remarkable findings related to species previously listed yet rarely found become apparent. A very unique case is that of the pomacentrid *Abudefduf hoefleri* (Plate 4, A). This species has been recently cited in Gran Canaria (ESPINO *et al.*, in press) on the grounds of a photograph of adult specimens showing the mating livery. However, the photographs we have examined show smaller specimens and their colouring is easily mistaken by the characteristic *Abudefduf saxatilis* colouring. The latter has also been previously listed in port areas in the Canarias based on photographs. Aiming to clarify this situation, we examined two specimens showing said colouring whose morphometric data are presented in Table 3. We concluded these were both *A. hoefleri* specimens, according to differentiation criteria proposed by EDWARDS (1986) – they showed slightly different values for the morphometric parameters with respect to those presented by said author, nonetheless –. The examination performed of a juvenile specimen also highlighted differences in colouring in regards to that attrib-

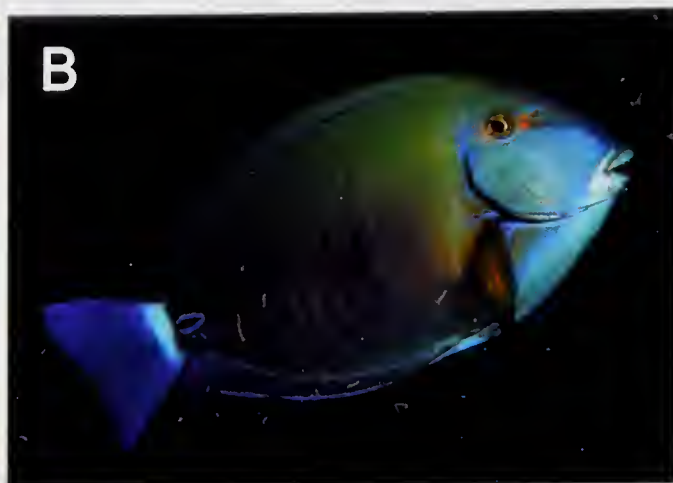


Plate 3.- A) *Acanthurus bahianus*; B) *Acanthurus chirurgus*; C) *Acanthurus coeruleus*; D) *Acanthurus tractus*; E) *Acanthurus monroviae*; F) catches of *Acanthurus monroviae* in Gran Canaria.

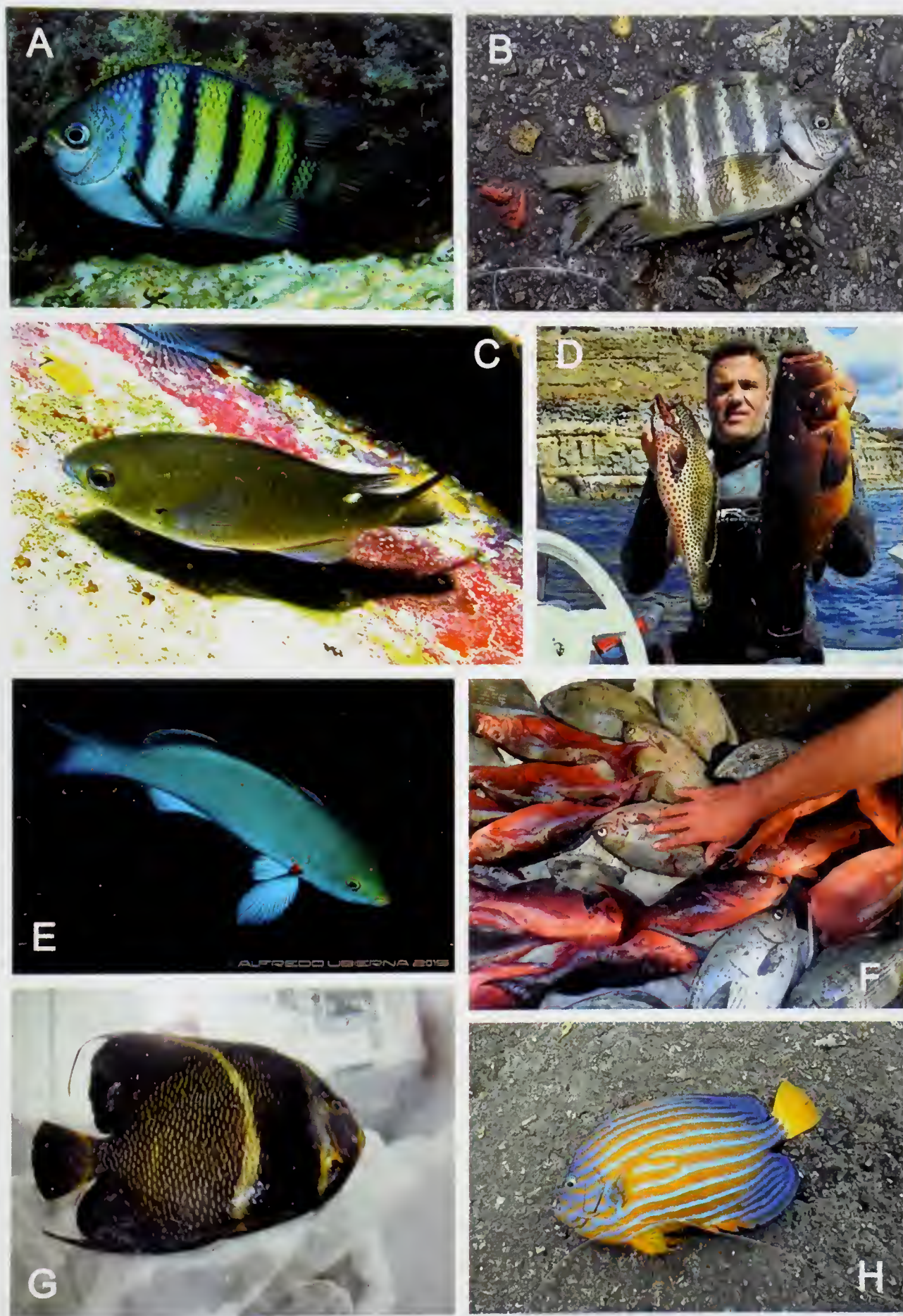


Plate 4.- A) *Abudefduf hoefleri*; B) *Abudefduf* cf. *taurus*; C) *Chromis multilineata*; D) *Cephalopholis* cf. *cruentata* caught alongside *Epinephelus marginatus*; E) *Paranthias fucifer*; F) catches of *Paranthias fucifer* and *Kyphosus* sp. at Las Palmas de Gran Canaria port; G) *Pomacanthus paru*; H) *Chaetodontoplus septentrionalis*.

Table 3.- Counts and measurements (in mm) on fresh specimens of *Abudefduf hoefleri* from the Canary Islands (total length: 205 mm and 150 mm); percentage of morphometric data refer to standard length.

Specimen	Standard length	Head length	Body depth	Head breadth	Least depth caudal peduncle	3º dorsal spine length	Dorsal fin rays	Anal fin rays
1	147	41.0 27.8 %	78.0 18.8 %	27.7 15.5 %	22.8 15.5 %	19.3 13.1 %	XIII + 14	II + 13
2	107	30.2 28.2 %	55.2 51.5 %	21.5 20.0 %	17.0 15.8 %	14.2 13.2 %	XIII + 14	II + 13

uted to young *A.saxatilis* (see FROESE & PAULY, 2015). Recently – September 2015 –, the first catch of this species was recorded in Tenerife (Punta de Teno), where other individuals were also observed.

It is also worth mentioning how often photographs of living as well as caught *Acanthurus monroviae* (Plate 3, E-F) specimens are seen. This species was first recorded in the Canary Islands in 1991, and it has occasionally been spotted in Tenerife and Gran Canaria since (BRITO, *et al.*, 2005). Their presence in Puerto de Las Palmas port is now commonplace, as it is in the southern areas of the island, where small-scale fishery have registered a number of significant caught. Along these lines, two more specimens of *Cephalopholis taeniops* have been registered in the rocky bottoms surrounding Puerto de Las Palmas port in 2013 and 2014. The occurrence of this species had been previously detected in the two main port as linked to oil rigs coming from the Guinean Gulf (BRITO *et al.*, 2011). The caught of an African butterflyfish specimen – *Prognathodes marcellae* – in Castillo del Romeral (Gran Canaria) in 2014 alongside another one in Santa Cruz port in 2013 should be noted as well, given that these have become the third and fourth records in the Canarias (BRITO *et al.*, 2005).

In terms of species that have evidently been released into the sea from aquariums, up until now, only one *Pomacanthus maculosus* specimen showing adult colouring had been recorded (BRITO *et al.*, 2005), but another large specimen with sub-adult colouring was photographed in Los Cristianos (Tenerife) in November 2012.

DISCUSSION

Results show that the tropicalization process in Canarian littoral ichthyofauna has sped up after starting off steeply in the late 80s and the early 90s (BRITO *et al.*, 2005). Anthropogenic activities have been very much at the root of it, oil platforms having played an important role from 2009 onwards (BRITO *et al.*, 2011). This is especially true of certain oil rigs that have arrived at Puerto de Las Palmas de Gran Canaria harbour.

Amongst the newly identified species, only *Parablennius goreensis* is really likely to have reached the area through its own dispersal means. It is a case of natural enlargement of the distribution range. Its known area of distribution reached to the Banc d’Arguin in Mauritania according to BATH & WIRTZ (1992). It was first spotted in 2012 in Tenerife in a locality far away from the island’s ports, and has since spread over the entire archipelago, where it keeps a large population, possibly favoured by increased water tempera-

tures (VÉLEZ *et al.*, 2015). It is thought that it may have displaced *Parablennius pilicornis*, however, these two species coexist in Banc d'Arguin (BATH & WIRTZ, 1992). A similar happening to that of the gobiid *Gnatholepis thomsoni*, recorded for the first time in Canarias in 1998. Nowadays, this species is abundantly present in all islands (BRITO *et al.*, 2005; A. BRITO, unpublished data), and it even reached Madeira in 2002 and has shown an increased population in recent years (WIRTZ *et al.*, 2008).

Three of the species were clearly originally specimens bred in aquariums and released into the sea once they reached large sizes. Such is the case of the two species of *Heniochus* and *Chaetodontoplus septentrionalis*, given that their areas of distribution are located far away, beyond the Atlantic Ocean, they are part of the contingent of fish involved in the international aquarium trade, and specimens seen are always large in size. We had previously detected one case when *Pomacanthus maculosus* appeared in Tenerife (BRITO *et al.*, 2005). This species is original from the Red Sea and areas close to the western section of the Indian Ocean. We have now also registered another specimen in the island. It seems highly unlikely for these very thermophilic species showing such low frequency of occurrence to develop populations in the Canarias, thus becoming an environmental problem. There is more room for discussion in the case of *Pomacanthus paru*, a species original from the tropical western Atlantic. Although it is part of the aquarium trade, it has also been found to be associated to oil rigs (i. e., RAUCH, 2004).

We cannot rule out the potential for some of the species to have arrived carried by ballast water, especially in the case of small sized species, given that other cases known can only be explained by this means of transport, recorded in the surroundings of the main ports. The most spectacular amongst them is the butterflyfish *Chaetodon sanctaehelenae*, endemic to Saint Helena and Ascension Island in the tropical central Atlantic (FROESE & PAULY, 2015). Six expatriate specimens of this species were registered in Santa Cruz port and its surrounding towards the south of the island between 1993 and 1998 (BRITO & FALCÓN, 1996; BRITO *et al.*, 2005). These are its only records outside of its natural distribution area. Another specimen was photographed later on in Las Eras (eastern coast of Tenerife) in October 2006.

For the majority of the newly recorded species, the introduction vector appears to have been fouling associated transport in oil rigs. They have been recorded in Gran Canaria, in the Las Palmas port and its surroundings, although *Cephalopholis cruentata*, *Abudefduf hoefleri*, *Hypleurochilus* and certain acanthurids show records in remote locations on the island. The analysis of the species' geographical distribution has pointed out that platforms must have arrived from three biogeographic provinces – the Guinean Gulf, and the northern and the southern regions of the tropical western Atlantic –. This becomes especially apparent in the case of the five acanthurid species. Information available confirms both this and that oil rigs coming from the western Atlantic brought along large masses of fouling, including coral formations. On a different note, most recorded species belong to families that do not typically spread out and cross biogeographic borders by the means of rafting (i. e. LUIZ *et al.*, 2015), and their association to oil platforms is however well known (i. e., RAUCH, 2004; FRIEDLANDER *et al.*, 2015). During their studies in Gabon platforms, the latter authors found that the most abundant species in terms of number of specimens and biomass was *Paranthias furcifer*, the second and third ones in number of specimens being *Chromis multilineata* and *Abudefduf hoefleri*. *Acanthurus monroviae* achieved significant

representation in terms of weight , however smaller than that of the two pomacentrids. These same authors attribute a high value in terms of number of specimens and a slightly lower value in weight to an unidentified species belonging to the *Kyphosus* genus. In that respect, it is also worth mentioning that photographs of fishing catches taking place in areas close to Puerto de Las Palmas harbour as well as other photographs taken from the outer dike of said port between 2014 and 2015 have been examined and seen to show specimens of a *Kyphosus* species that may well not be the one native to the Canarias. Failing to get hold of specimens, identification was not possible. Furthermore, a noticeable discussion on the issue of the identity of different Atlantic species is currently taking place (R. FRICKE, *com. in litt.*).

It is clear now that the arrival of oil platforms to the two main ports in the Canary Islands for the purposes of cleaning and repair works – a commercial activity currently blooming with further growth predicted in the years to come – may well give rise to transformations in the coastal ichthyofauna and marine ecosystems of the Canary Islands. All the more since transport takes place from tropical areas in a current context of climate change that is causing the archipelago's shallow waters' temperatures to raise, especially so during the wintertime (VELEZ et al., 2015). However true that emigrated thermophilic species may find it difficult to breed, we have evidence that at least two species – *Hypleurochilus pseudoaequipinnis* and *Abudefduf hoefleri* – already are reproduced in Gran Canaria.

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REFERENCES

- AFONSO, P., F. M. PORTEIRO, J. FONTES, F. TEMPERA, T. MORATO, T., F. CARDIGOS & R. S. SANTOS. 2013. New and rare coastal fishes in the Azores islands: occasional events or tropicalization process? *Journal of Fish Biology* 83: 272-294.
- ALLEN, G. 2010. *Chaetodontoplus septentrionalis*. The IUCN Red List of Threatened Species 2010:e.T165882A6156389.
<http://dx.doi.org/10.2305/IUCN.UK.2010RLTS.T165882A6156389.en>
- BAÑON, R., R. VILLEGAS-RÍOS, A. SERRANO, G. MUCIENTES, & J. C. ARRONTE. 2010. Marine fishes from Galicia (NW Spain): an updated checklist. *Zootaxa* 2667: 1-27.
- BATH, H. 1977. Revision der Blenniini (Pisces: Blenniidae). *Senckenbergiana Biologica* 57 (4/6): 167-234.

- BATH, H. 1990. Taxonomie und Verbreitung von *Parablennius* Ribeiro 1915 an der W-Küste Afrikas und den Kapverdischen Inseln mit Revalidation von *P. verryckeni* (Poll 1959) und Beschreibung drei neuer Arten (Pisces: Blenniidae). *Senckenbergiana Biologica* 70 (1/3): 15-69.
- BATH, H. 1994. Untersuchung der Arten *Hypleurochilus geminatus* (Wood, 1825), *H. fissicornis* (Quoy & Gaimard 1824) und *H. aequipinnis* (Günther 1861), mit Revalidation con *Hypleurochilus multifilis* (Girard 1858) und Beschreibung von zwei neuen Arten (Pisces: Blennidae). *Senckenbergiana Biologica* 74 (1/2): 59-85.
- BATH H. & P. WIRTZ. 1992. On a collection of blenniid fishes from Mauritania, with a redescription of *Spaniblennius rioudourensis* (Metzelaar, 1919). *Zoologische Mededelingen* 66 (13): 265-272.
- BERNAL, M. A. & L. A. ROCHA. 2011. *Acanthurus tractus* Poey, 1860, a valid western Atlantic species of surgeonfish (Teleostei, Acanthuridae), distinct from *Acanthurus bahianus* Castelnau, 1855. *Zootaxa* 2905: 63-68.
- BRITO, A. & J. M. FALCÓN. 1996. Capture of the St. Helena butterfly fish, *Chaetodon sanctaehelenae* (Chaetodontidae) in the Canary Islands. *Cybium* 20 (1): 99-100.
- BRITO, A. & J. M. FALCÓN. 2007. Primera cita para Canarias de dos nuevos peces de origen tropical: *Diodon holocanthus* Linnaeus, 1758 y *Canthidermis maculata* (Bloch, 1786). *Revista de la Academia Canaria de Ciencias*, 18 (4): 89-92.
- BRITO A., J. M. FALCÓN & R. HERRERA. 2005. Sobre la tropicalización reciente de la ictiofauna litoral de las islas Canarias y su relación con cambios ambientales y actividades antrópicas. *Vieraea* 33: 515-525.
- BRITO, A., R. HERRERA, J. M. FALCÓN, J. A. GARCÍA-CHARTON, J. BARQUÍN & A. PÉREZ-RUZAF. 1999. Contribución al conocimiento de la ictiofauna de las islas de Cabo Verde. *Revista de la Academia Canaria de Ciencias* 11 (3-4): 27-41.
- BRITO, A., S. CLEMENTE, & R. HERRERA. 2011. On the occurrence of the African hind, *Cephalopholis taeniops*, in the Canary Islands (eastern subtropical Atlantic): introduction of large-sized demersal littoral fishes in ballast water of oil platforms? *Biological Invasions* 13: 2185-2189.
- CLEMENTE, S., J. C. HERNÁNDEZ, A. RODRÍGUEZ, & A. BRITO. 2010. Identifying keystone predators and the importance of preserving functional diversity in sublittoral rocky-bottom áreas. *Marine Ecology Progress Series* 413: 55-67.
- EDWARDS, A. 1986. A new damselfish, *Chromis lubbocki* (Teleostei: Pomacentridae) from the Cape Verde Archipelago, whit notes on other Eastern Atlantic pomacentrids. *Zoologische Mededelingen* 60: 181-207.
- ESPINO, F., F. TUYA & A. BRITO. En prensa. Occurrence of the African sergeant, *Abudefduf hoefleri* (Steindachner, 1881) (Actinopterygii: Pomacentridae) in the Canary Islands waters. *Revista de la Academia Canaria de Ciencias*.
- FERREIRA, C. E. L., J. E. A. GONÇALVES & R. COUTINHO. 2006. Ship hulls and oil platforms as potential vector to marine species introduction. *Journal of Coastal Research* 39: 1340-1345.
- FRIEDLANDER A. M., E. BALLESTEROS, M. FAY & E. SALA. 2014. Marine Communities on Oil Platforms in Gabon, West Africa: High Biodiversity Oases in a Low Biodiversity Environment. *PLoS ONE* 9 (8): e103709.doi:10.1371/journal.pone.0103709-

- FROESE, R. & D. PAULY. Editors. 2015. FishBase. World Wide Web electronic publication. www.fishbase.org, version (04/2015).
- GARCÍA-MEDEROS, A. M. & V. M. TUSET. 2014. First record of African brown snapper *Lutjanus dentatus* in the Canary Islands (north-eastern Atlantic Ocean). *Marine Biodiversity Records*, doi: 10.1017/S1755267214000682; Vol. 7; e65; page 1-3.
- HERNÁNDEZ, J. C., S. CLEMENTE, C. SANGIL & A. BRITO. 2008. The key role of the sea urchin *Diadema* aff. *antillarum* in controlling macroalgae assemblages throughout the Canary Islands (eastern subtropical Atlantic): a spatio-temporal approach. *Marine Environmental Research* 66:259-270.
- OSMAR J. L., A. P. ALLEN, D. R. ROBERTSON, S. R. FLOETER, & J. S. MADIN. 2015. Seafarers or castaways: ecological traits associated with rafting dispersal in tropical reef fishes. *Journal of Biogeography*, doi: 10.1111/jbi.12574.
- OTERO-FERRER, F., R. HERRERA, A. LÓPEZ, J. SOCORRO, L. MOLINA & C. BOUZA. 2015. First records of *Hippocampus algiricus* in the Canary Islands (north-east Atlantic Ocean) with an observation of hybridization with *Hippocampus hippocampus*. *Journal of Fish Biology*, doi:10.1111/jfb.12760
- PYLE, R., MYERS, R., ROCHA, L.A. & CRAIG, M.T. 2010. *Pomacanthus paru*. The IUCN Red List of Threatened Species 2010: e.T165898A6160204. <http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T165898A6160204.en>
- RAUCH, T. J. 2004. Predators and the Distribution and Abundance of Blennies on Offshore Petroleum Platforms. *Gulf and Caribbean Research* 16 (2): 141-146.
- VÉLEZ P., M. GONZÁLEZ, M. D. PÉREZ & A. HERNÁNDEZ. 2015. Open ocean temperature and salinity trends in the Canary Current Large Marine Ecosystem. En Valdés J. L. and Déniz G. I. (2015) “*Oceanographic and biological features in the Canary Current Large Marine Ecosystem*”. IOC-UNESCO, 13 pp. IOC Technical Series 115. Paris.
- WIRTZ, P., C. E. L. FERREIRA, S. R. FLOETER, R. FRICKE, J. L. GASPARINI, T. IWAMOTO, L. ROCHA, C. L. S. SAMPAIO & U. K. SCHLIEWEN. 2007. Coastal Fishes of São Tomé and Príncipe islands, Gulf of Guinea (Eastern Atlantic Ocean)-an update. *Zootaxa* 1523: 1-48.
- WIRTZ, P., FRICKE, R. & M. J. BISCOITO. 2008. The coastal fishes of Madeira Island – new records and an annotated check-list. *Zootaxa* 1715: 1-26.
- WOLFSON, A. (1976). Submerged platform structure communities. In A. J. Mearns and M. M. Moore (Eds), *Biological Study of Oil Platforms Hilda and Hazel, Santa Barbara Channel, California, Final Report*. Institute of Marine Resources, Scripps Institution of Oceanography, La Jolla, California. pp. 3844.
- ZENETOS, A. S. GOFAS, C. MORRI, A. ROSSO, D. VIOLANTI, J. E. GARCÍA RASO, M. E. ÇINAR, A. ALMOGI-LABIN, A. S. ATES, E. AZZURRO, E. BALLESTEROS, C. N. BIANCHI, M. BILECENOGLU, M. C. GAMBI, A. GIANGRANDE, C. GRAVILI, O. HYAMS-KAPHZAN, P. K. KARACHLE, S. KATSANEVAKIS, L. LIPEJ, F. MASTROTOTARO, F. MINEUR, M. A. PANCUCCI-PAPADOPOULOU, A. RAMOS-ESPLÁ, C. SALAS, G. SAN MARTÍN, A. SFRISO, N. STREFTARIS & M. VERLAQUE. 2012. Alien species in the Mediterranean Sea by 2012. *Mediterranean Marine Science* 13/2: 328-352.